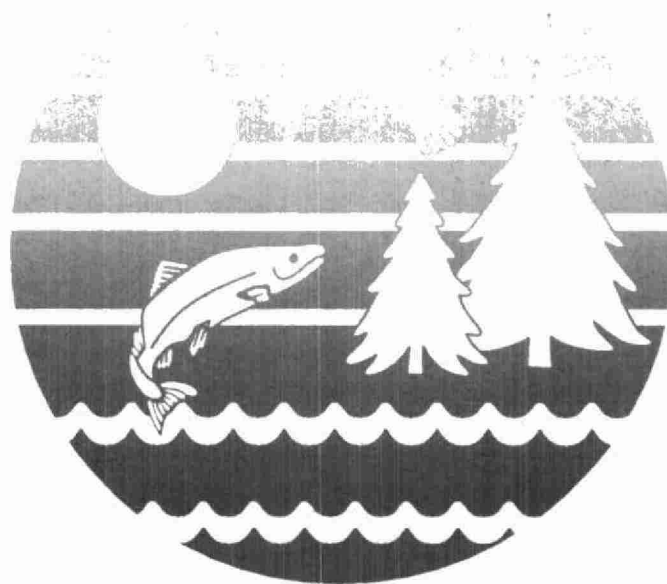


Laboratory Services Branch Operational Outline



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LABORATORY SERVICES BRANCH

ONTARIO MINISTRY OF THE ENVIRONMENT

OPERATIONAL OUTLINE

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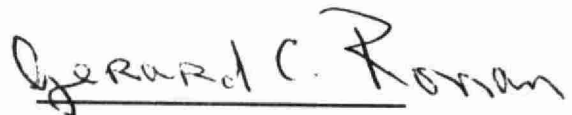
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FOREWORD FROM THE DIRECTOR

The inner workings of a large laboratory branch that bridges so many disciplines and provides such a multitude of varied technical services are by nature complex. This document reflects our commitment to increase the understanding of how the branch operates to support environmental protection programs in Ontario.

Operational Outline presents a detailed outline of our organization and the work we do in four technical and one administrative section. It is designed to give staff, client groups and interested individuals an insight into our philosophy as well as a clear understanding of how we operate.

A handwritten signature in dark ink, reading "Gerard C. Ronan". The signature is written in a cursive style with a horizontal line underneath the name.

Gerard C. Ronan
Director

LOOKING BACK: AN INTRODUCTION

The laboratory was first established in 1956 as the Laboratories and Research Division of the Ontario Water Resources Commission, with 24 personnel transferred from the Ontario Department of Health. The original mandate was mainly "water supply, sewage works, industrial and stream sanitation analysis" and the total analytical capability was approximately 30 tests, primarily inorganic.

Over the next fifteen years, the laboratory expanded its range of analytical services to include trace metals and a small range of organic chemicals. In 1971-72, the Ontario Water Resources Commission became the Ministry of the Environment and an integrated Laboratory Services Branch was formed, encompassing all air, vegetation, and soils analyses, in addition to the existing drinking water, surface water, and sewage monitoring capability.

The Ontario Environment Laboratory is considered to be one of the foremost environmental laboratories in North America. Key features are the wide ranging test capabilities, the high-volume work output, and the low-level detection capabilities. Whether analyzing for ultra-trace constituents in precipitation or dioxin isomers in fish, the laboratory has created a reputation for excellence in method development and routine analytical procedures.

Current capacity enables the laboratory to handle a large number of matrices including air, water, wastewater, vegetation, biota, sediments and soils for several hundred organic and inorganic parameters. The central laboratory also possesses a comprehensive array of state-of-the-art diagnostic tools to identify a myriad of compounds of environmental significance.

MANDATE TOWARDS ANALYTICAL EXCELLENCE

As the analytical arm of the Ministry of the Environment, our mandate is to develop and maintain a state-of-the-art environmental laboratory, dedicated to providing analytical excellence at all levels of support for Ontario's environmental protection programs.

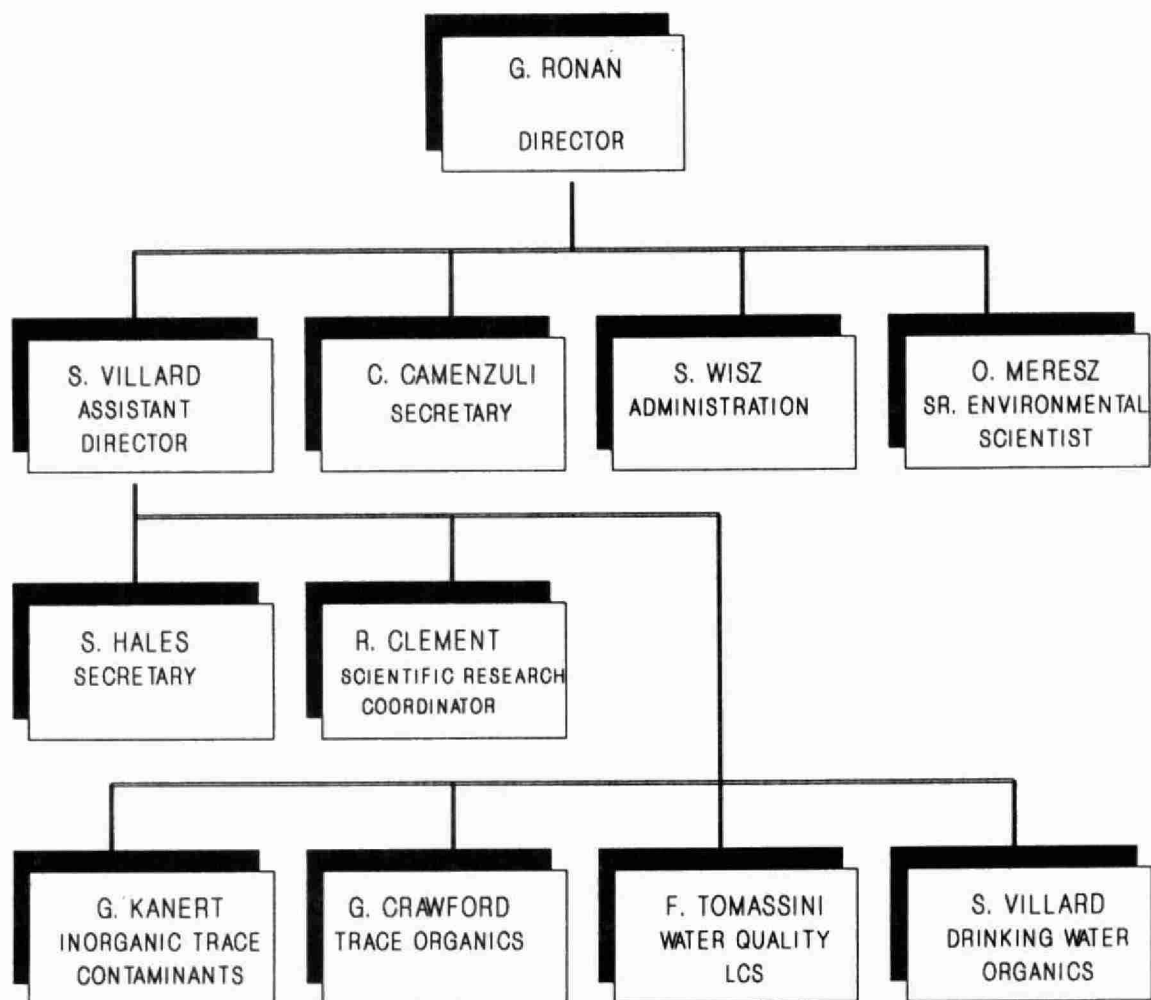
To assist in achieving our mandate, the following branch mission statement has been developed:

To develop and maintain an environmental centre of excellence which provides:

- **High quality analytical services, including isolation, identification and measurement of environmental contaminants;**
- **A Reference Centre for environmental analysis;**
- **Expert consultation on environmental analysis;**
- **Research and development for methodology enhancement/ advancement.**

In addition, laboratory personnel provide scientific and technical expertise to other government agencies and laboratories around the world.

LABORATORY SERVICES BRANCH

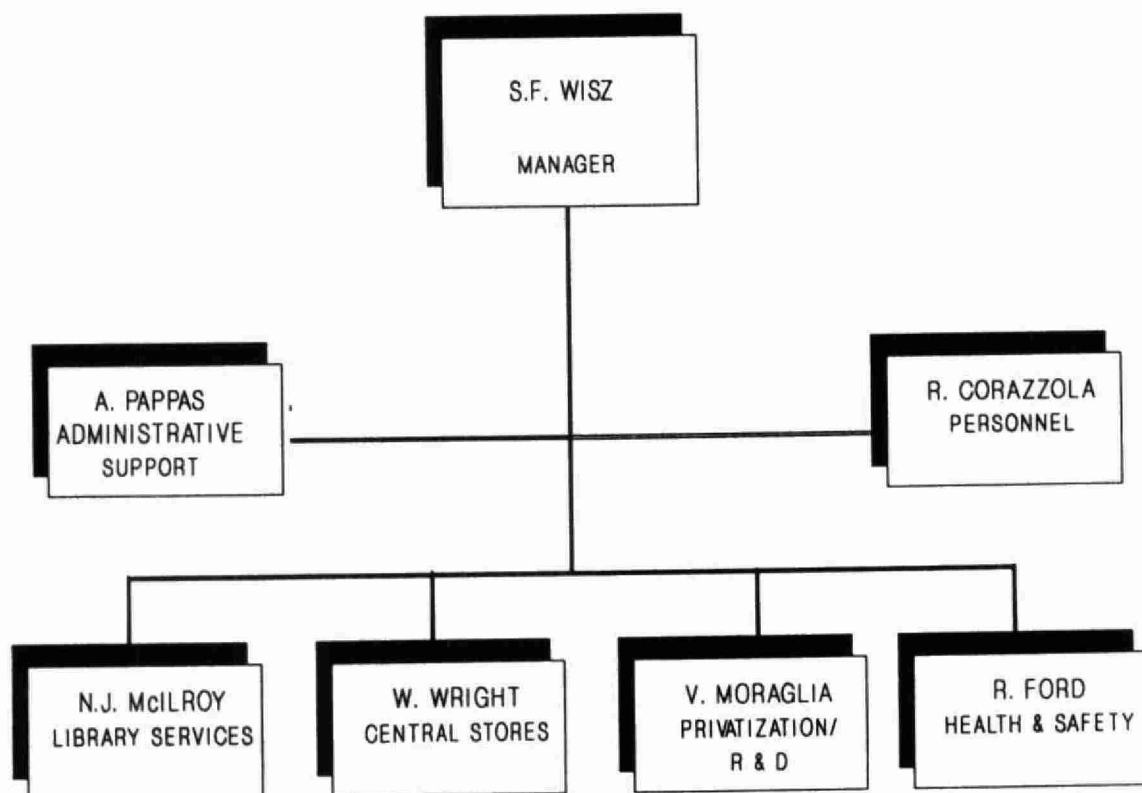


DIRECTOR AND ASSISTANT DIRECTOR

The director is responsible for the technical and administrative management of the laboratory. Long range planning, budgeting, staffing allocations, technical direction of regional laboratories, and ministry-wide quality assurance initiatives, are illustrative of key director duties.

The assistant director manages the laboratory production. Other key duties include workload planning, productivity enhancements, equipment acquisitions, building renovations, and coordination of the branch privatization and research activities.

LABORATORY SERVICES BRANCH ADMINISTRATION SECTION



ADMINISTRATION SECTION

The Administration Section coordinates personnel, financial, planning and administrative support services for the Laboratory Services Branch. The section also administers a Health and Safety Program for the complex and provides the scientific liaison for privatization and research and contracts.

The Section is organized into five areas:

- Administrative Support Unit
- Privatization and Research and Development
- Health and Safety
- Central Stores
- Library Services

ADMINISTRATIVE SUPPORT UNIT

This Unit ensures that effective use is made of human and financial resources by advising management on staffing and budgetary concerns. The group administers branch budgets, establishes expenditure control procedures and liaises with the Assistant Deputy Minister's office regarding financial matters. The personnel services provided by this Unit include overseeing organizational changes and advising on complement and casual staff control and assignments, attendance summaries, and staff benefits.

General office support services such as word processing, reception, filing, photocopying, mail, petty cash, emergency purchase orders and building accommodation matters are provided along with a myriad of miscellaneous services such as answering enquiries from the general public, arranging laboratory tours, scheduling use of the lecture hall and main boardroom, maintaining staff lists and vehicle licence

numbers for the complex and coordinating the use and maintenance of Ministry vehicles. The group also works with the Ministry of Government Services to coordinate maintenance, housekeeping, cafeteria and general upkeep of the building and grounds.

The administrative manager oversees the smooth functioning and interaction of all administrative support, library, central stores services, and contract administration. He also works with the safety officer to ensure branch awareness of all safety and health imperatives.

PRIVATIZATION AND RESEARCH & DEVELOPMENT

The Laboratory Services Branch scientific liaison officer oversees the administration of both research and method development and analytical workload privatization.

The scientific liaison officer administers contracts for the privatization of analytical work, provides a coordinating role for the process and maintains contract financial records. Branch technical liaison officers have been assigned to the individual programs to provide scientific expertise and approve the data generated by the private laboratories.

The scientific liaison officer is responsible for administering contracts for the branch research activities and coordinates the tendering process for analytical RAC funded contracts. Also, an inventory and computerized tracking system of all research and development activities is maintained.

HEALTH AND SAFETY

A comprehensive Health & Safety Program is carried out to ensure that all laboratory personnel enjoy a safe working environment.

The safety officer schedules and provides training in fire prevention, first-aid, orientation for new employees, spills, chemical handling, personal protection, emergency procedures, self contained breathing apparatus, etc.

The laboratory contains numerous hazards such as compressed gases, flammable and combustible materials, oxidizing materials, poisonous and infectious materials, corrosive materials, and dangerously reactive materials. WHMIS (Workplace Hazardous Material Information System) training covers the hazardous materials mentioned above. The WHMIS Training Program incorporates labelling, education and Material Safety Data Sheets (MSDS). MSDS are maintained and located

throughout the laboratory for use by staff both in hardcopy and computer based forms in order to provide easily accessible technical information about chemicals.

Regular updates of the Laboratory Safety Manual, Fire Evacuation Plan, Orientation Package and Emergency Procedures Plan are done. The complete laboratory chemical inventory is kept up-to-date in the safety office with reference to the sections, room number, chemicals, and manufacturers.

Other programs under the jurisdiction of the safety office are workplace inspections, air-monitoring, medical surveillance programs, designated substance assessments, fumehood inspections and validations, accident investigation, safety equipment purchase and maintenance, WCB, administration, etc.

The safety officer attends all Joint Health & Safety Committee meetings as a resource person, is chairman of the Ergonomic Committee, a permanent member of the Ministry of the Environment Technical Health & Safety Committee and a member on the MOE/MGS Liaison Committee. In addition, this officer investigates all accidents and ensures that all reports are completed and distributed to the appropriate people. He also liaises with private and government laboratories and other agencies as a resource person.

CENTRAL STORES

All requisitions, local purchase orders, cheques, reports and correspondence related to stores activities are processed by this Unit. They also answer client enquiries, maintain a filing system, assign inventory tags, expedite goods ordered, issue receiving reports for all goods and services and distribute goods received throughout the complex. Stock is assigned to the proper storage area (acid room, solvent room, gas cylinder room, etc.), dated, coded and shelved. Laboratory supplies requisitions are completed and monthly chargeback summaries prepared. An accurate supplies inventory is maintained and prices adjusted as received into stock.

In addition, this Unit is responsible for washing, sterilizing, labelling and assembling sample container kits to accommodate the needs of laboratory and field clients.

Shipping and receiving functions include the distribution of supplies and sample containers to the regional laboratories, water and wastewater treatment plants and Ministry field crews. A number of miscellaneous support services are also performed such as sorting mail, delivering gas cylinders, distributing lab coats to staff, and coordinating the storage and disposal of waste chemicals.

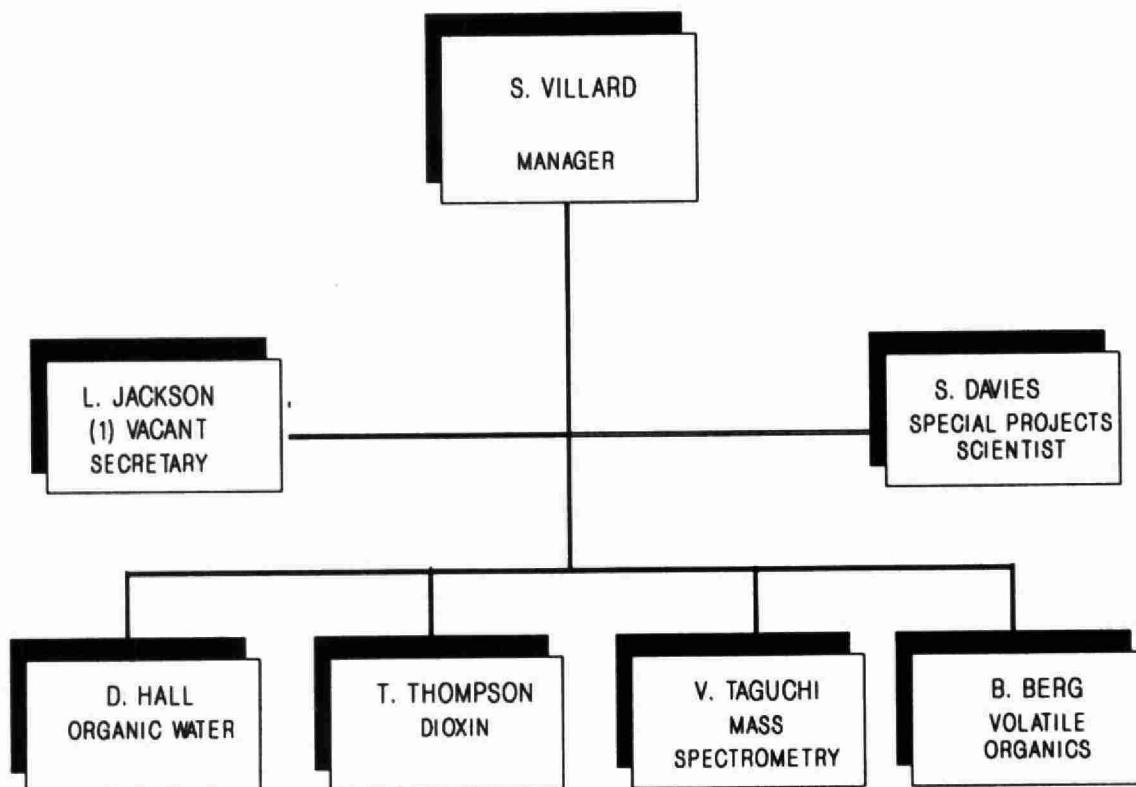
Quality Control activities include all sample bottles and chemicals issued. Waste handling, under Regulation 309, is coordinated and processed by this Unit. Recycling of various chemical wastes, glass, plastic and cardboard is also performed.

LIBRARY SERVICES

The laboratory library provides scientific and technical information to the professional and technical staff of the laboratory complex. It acquires, catalogues, indexes, publishes, and circulates books and government documents. The library has a collection of 145 journal subscriptions and the information they contain is made available to the staff by circulating the table of contents and subsequently circulating the journal issues upon request.

The library provides a reference service consisting of access to our scientific and technical information via an on-line catalogue of the library collection, on-line information retrieval using other government and commercial databases, inter-library loans throughout North America, and a collection of scientific, technical, and general reference tools.

LABORATORY SERVICES BRANCH DRINKING WATER ORGANICS SECTION



DRINKING WATER ORGANICS SECTION

The Drinking Water Organics Section's principle task is the analysis of organic chemicals in drinking, ground and surface water supplies and ultra-toxic organic chemicals such as dioxin in water and many other sample types.

The section provides both qualitative and quantitative analysis of all drinking, surface, river and lake waters for a wide variety of chlorinated organics, herbicides, pesticides, priority organics, purgeables and trihalomethanes.

Capabilities also include ultra-trace quantitative analysis of environmental matrices for polychlorinated dibenzo-dioxins and polychlorinated dibenzofurans most notably 2,3,7,8-TCDD. Characterization of organics by mass spectrometry in support of Ministry landfill, effluent and water programs is also provided.

Drinking Water Organics consists of four units:

- **Dioxin Unit**
- **Mass Spectrometry Unit**
- **Volatile Organics Unit**
- **Organic Water Unit**

The section utilizes state-of-the-art analytical equipment and methodology to provide the most sensitive and up-to-date analyses possible. Each unit is at the forefront of new developments in its specific field. New methodologies are being pioneered and implemented within the section on an on-going basis.

DIOXIN UNIT

The Dioxin Laboratory was established in 1981 to address the discovery of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) in Great Lakes fish. It was the first facility in North America dedicated to this task.

Although routine monitoring of 2,3,7,8-TCDD in Ontario sports fish is still an important program, the Dioxin Unit has expanded its analytical capabilities to include other biota, ground and surface waters, industrial effluents, drinking water, soils, sediments, incinerator emissions, and sludges.

Samples are now analyzed for a wide range of polychlorinated dibenzo-p-dioxin (PCDD) congeners and also for polychlorinated dibenzofurans (PCDF), a closely related class of compounds with similar chemical and toxicological properties.

The Dioxin Unit analyzes Ontario sports fish for part-per-trillion levels of PCDD and PCDF. The data are used by the Ministry in publishing the "Guide to Eating Ontario Sports Fish". Other programs supported by the Unit include the determination of dioxins and furans in raw and treated drinking water, evaluation of incinerator emissions, provision of chemical analyses for the Niagara River Program, and the monitoring of effluent discharges for the Municipal and Industrial Strategy for Abatement (MISA) Program.

The Dioxin Unit is committed to maintaining its state-of-the-art position in all aspects of the analysis of chlorinated dioxins and furans. This is achieved by improving and developing analytical methodologies as well as reviewing the scientific literature and attending conferences. New findings and developments are frequently presented at international symposia and published in scientific journals.

MASS SPECTROMETRY UNIT

The Mass Spectrometry Unit's principle function is the characterization of trace amounts of unknown organic contaminants in the environment. Although the bulk of the Unit workload is characterization some "target" compound analysis is performed. Compound identification and quantitation are done using mass spectrometers.

The characterization capabilities include the identification of unknown compounds, the confirmation of known compounds and the quantification of these compounds.

Analyses are performed in a wide variety of sample matrices including water, effluent, sediment, biota and air.

The Unit provides analytical support and mass spectrometry expertise for other organic laboratories within the Branch and for many programs in other branches and regions in Ontario.

The analyses performed by this Unit can be classified by the following categories:

- volatile organics (low molecular weight)
- extractable organics (medium molecular weight)
- dioxin confirmation by high resolution mass spectrometry (HRMS) and tandem mass spectrometry (MS/MS)
- identification and confirmation of unknowns by low resolution mass spectrometry (LRMS), HRMS and MS/MS

Volatile organics are analysed using a purge and trap system coupled to a gas chromatograph/mass spectrometer (GC/MS). The MS used for this application is a relatively low cost mass selective detector (MSD). Extractable organics are analyzed on a more sophisticated GC/MS system, the Finnigan 4500.

The tandem mass spectrometer is a triple quadrupole MS/MS which is primarily used for the dioxin analysis of difficult matrices. It is used because of its selectivity (low chemical noise).

The high resolution mass spectrometer is the most sophisticated MS within the Ministry. Its unique capabilities include the determination of accurate masses and differentiation of these accurate masses. It can differentiate between a target analyte and possible interferences. It is therefore used to confirm the presence of the chlorinated dibenzo-p-dioxins (CDD) and dibenzofurans (CDF). It can also be used to identify unknowns by exact molecular weight determination.

VOLATILE ORGANICS UNIT

The Volatile Organics Unit is responsible for the routine analysis of surface water, ground water, and drinking water supplies for 27 volatile organic compounds, essentially aromatic and chlorinated solvents. The Unit's list of compounds varies to reflect the changing concerns of Ministry drinking water programs but is based on volatile pollutants which are commonly found in landfill sites, observation wells and other common environmental problem areas such as the Niagara River. In addition, the Unit also tests for trihalomethanes originating from numerous water treatment plants where chlorine is used as a disinfectant for pathogenic organisms.

The quality of Ontario drinking water supplies are constantly monitored by this Unit. Drinking water samples are compared with drinking water objectives, and evaluated to ensure that Ontario drinking water conforms to guidelines set forth by various agencies in North America.

The Volatile Organics Unit maintains a high sample throughput monitored by strict quality assurance guidelines. Analysis of the "target" compounds is accomplished by the use of capillary gas chromatography with a variety of gas chromatographic detectors. Additional, critical confirmatory analyses are carried out by mass spectrometry in the Unit. The identification of newly detected pollutants discovered during the routine monitoring is referred to the Mass Spectrometry Unit.

ORGANIC WATER UNIT

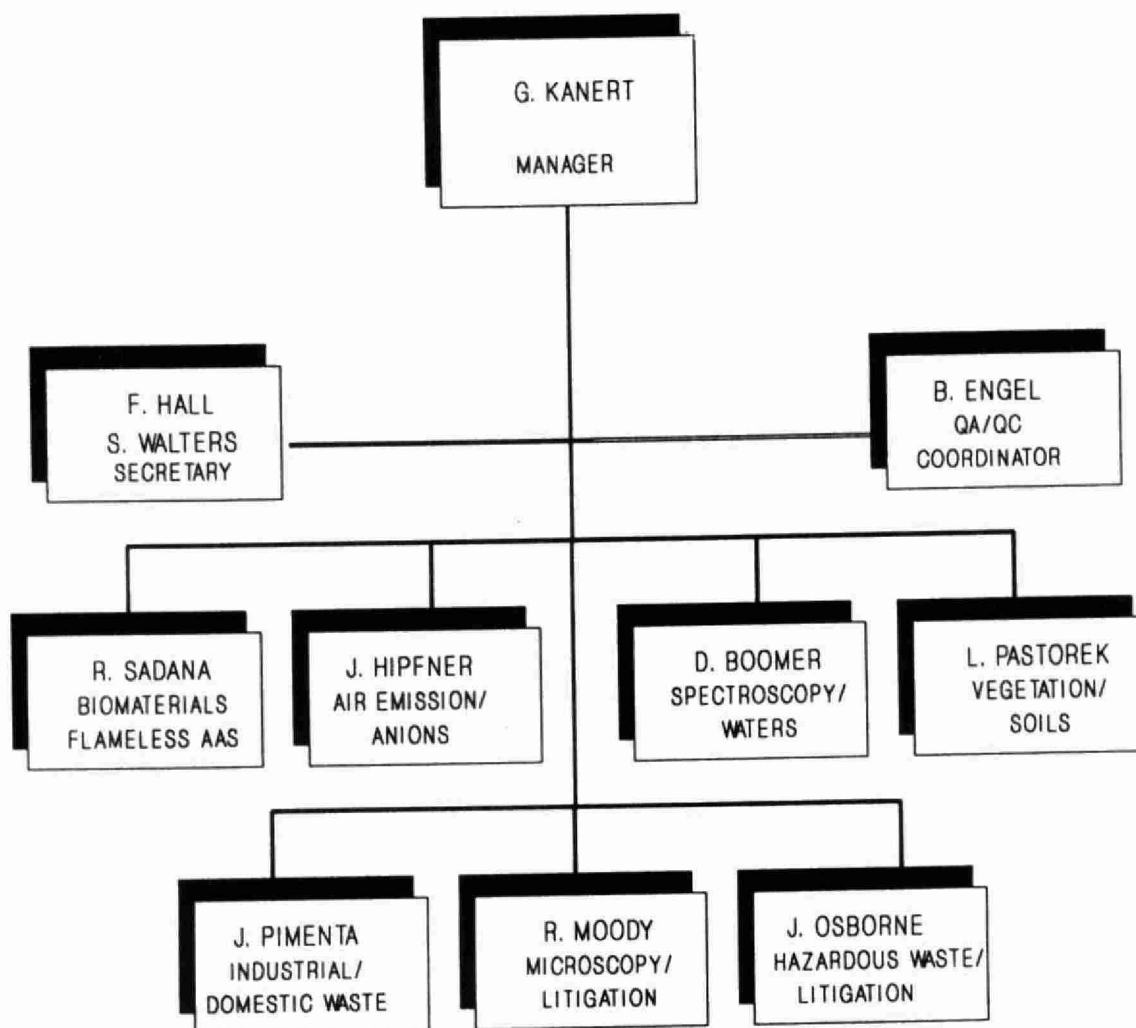
The Organic Water Unit analyzes surface water, ground water and drinking water supplies for semi-volatile and non-volatile organic chemicals. The group routinely analyses for a wide variety of classes of organic compounds including triazines, organophosphates, carbamates, phenylureas, organochlorines, chlorophenols, phenoxy acids, chloroaromatics, polychlorinated biphenyls (PCB) and polynuclear aromatic hydrocarbons (PAH) at the parts-per-trillion level.

These parameters are used to establish a database for the occurrence of these compounds in Ontario water supplies. The Unit provides analytical services and advice for the coordination of various branch and regional water testing initiatives such as the Drinking Water Surveillance (DWSP). PCBs in Well Water and Ground-water Monitoring programs.

The Organic Water Unit develops new analytical methodologies along with routinely upgrading existing methods and adding "target" compounds to previously established methods. All analyses are subjected to quality assurance guidelines. The Unit produces high quality analytical data while maintaining fast turnaround in data reporting and high sample throughput.

The Organic Water Unit frequently encounters analytical tasks relating to environmental spills and episodes, and develops methodology as required to ensure fast, accurate and efficient reporting of resulting data. The group also consults with clients regarding chemical properties, possible point of origin, and environmental impact.

LABORATORY SERVICES BRANCH INORGANIC TRACE CONTAMINANTS SECTION



INORGANIC TRACE CONTAMINANTS SECTION

The Inorganic Trace Contaminants Section is a multifunctional section and is responsible for:

- Analysis of inorganic chemicals in simple and complex matrices;
- Identification and characterization analysis of hazardous organic compounds in industrial wastes and landfill samples;
- Mobile on-site analytical support for environmental field work and emergencies;
- Coordinating support for legal sample analyses throughout the Branch.

The section provides the following analytical services in support of a wide range of programs:

- Determination of all major anions, cations and trace metals in complex environmental matrices such as soils, sediments, aquatic and terrestrial vegetation, biomaterials, dustfall and air filters;
- Analysis of clean waters (surface, ground and precipitation), wastewater, sewage and sludge for trace metals with the exception of calcium, magnesium, sodium and potassium;
- Identification and analysis of solids and particulate matter for inorganics;

- Analysis of water, effluents, soil, vegetation, oil and sludge for hazardous organic compounds.

The largest percentage of the workload in the section is in the area of trace metal analysis.

The section consists of 62 scientific, technical, and clerical support personnel in the following seven analytical units:

- Industrial/Domestic Waste Unit
- Biomaterials/Flameless AAS Unit
- Air Emission/Anions Unit
- Vegetation/Soils Unit
- Spectroscopy/Waters Unit
- Microscopy/Litigation Unit
- Hazardous Waste/Litigation Unit

The section utilizes state-of-the-art instrumentation and methodology to provide sensitive, accurate and timely analyses.

The inorganic analysis component of the section relies heavily on inductively coupled plasma optical emission and mass spectroscopy (ICP-OES) for multi-element analyses. Direct current plasma optical emission spectroscopy (DCP-OES) is also used for multi-element scans. Single element analyses are performed by atomic absorption spectrophotometry (flame, flameless and carbon rod). Microscopic techniques (light and electron) and X-ray spectroscopy are used for particle and solid material identification.

For organic parameter identification and analysis, the Hazardous Waste/Litigation Unit of the section uses gas chromatography mass spectroscopy and infrared spectroscopy (including Fourier-Transform infra red, FTIR).

Each unit within the section has a mandate to improve analytical techniques and assess new methodologies as required.

INDUSTRIAL/DOMESTIC WASTE UNIT

This Unit performs routine metals analyses using ICP-OES and DCP-OES on liquid and solid industrial waste, landfill leachate, sewage, sludge and effluent samples. Industrial waste samples are also tested for flash point, corrosivity and leaching characteristics. The Unit is heavily involved in the support of the MISA program and the analysis of legal samples.

The Unit is responsible for maintaining and expanding the laboratory's expertise in industrial waste analytical methodologies. As part of the Unit's on-going method development work, simple and rapid tests are being devised for use in waste characterization at landfill sites or in a mobile laboratory at remote locations.

BIOMATERIALS/FLAMELESS AAS UNIT

This Unit analyzes biomaterials and all environmental matrices for mercury, arsenic, selenium and antimony. Biomaterials are also analyzed for heavy metals. Special procedures have been developed for the analysis of industrial waste and terrestrial samples for programs such as MISA and the Acid Precipitation in Ontario Study (APIOS).

New instrumentation and methodologies are evaluated on a continuing basis. Currently, the Unit is completing the development of an automated procedure for the determination of mercury in water. A robotic system for the determination of mercury in biological tissue is also under development.

AIR EMISSIONS/ANIONS UNIT

The Air Emission/Anions Unit coordinates the analysis of routine dustfall and Hi-vol samples by private laboratories, monitoring turnaround times and approving data prior to its release to the laboratory clients. The Unit also performs an audit role by monitoring the quality of the data produced by private laboratories. Non-routine Hi-vol and dustfall samples, including those for special programs and legal submissions, are analyzed by the Unit. Hi-vol samples are analyzed for metals, free and total carbon, carbonate, uranium, anions, total respirable and non-respirable suspended particulate. Dustfall samples are analyzed for metals and anions. The insoluble particulate matter may be identified using microscopic techniques.

The Unit determines cyanide and sulphide concentrations in all samples submitted to the laboratory through various programs such as MISA and the Drinking Water Surveillance Program (DWSP).

The Unit frequently participates in the investigation and evaluation of new techniques for air sampling, such as the PM-10 inhaleable particulate program. The Unit is also responsible for the development of methods for the preparation and analysis of air related samples.

State-of-the-art ion chromatographic instrumentation is being used to develop analytical methods for new parameters of interest such as thiocyanate, cyanate and bromide in water and industrial effluent samples.

VEGETATION/SOILS UNIT

Vegetation, soil and sediment samples are analysed in this Unit for a large number of total and extractable metals and anions. Physical tests such as particle size, loss on ignition, percent moisture and pH are also performed on solid and sediment samples. The X-ray group offers instrumental support for potassium, sulphur and chlorine analysis in vegetation and titanium in soil.

This Unit provides support for many programs for Air Resources and Water Resources Branches as well as various regions. These programs include Terrestrial Effects, Sediment Waterfront Surveys and Soil Replacement Projects.

The Unit endeavors to maintain maximum efficiency and is continually evaluating and improving procedures. A robotic microwave sample preparation procedure is being developed. As well, automated and computerized systems are being used wherever possible to reduce throughput times.

SPECTROSCOPY/WATERS UNIT

The primary responsibility of this Unit is the analysis of precipitation, drinking and surface water samples for trace metals and major elemental components. This work is carried out in support of various programs including APIOS, DWSP, and the Provincial Water Quality Monitoring (PWQM) Program. In addition, analytical support is often provided to specific applied research projects initiated by scientists in other branches.

State-of-the-art instrumentation and computer systems are used to achieve better sensitivities and higher sample throughputs. Unit personnel have considerable expertise in the use of inductively coupled plasma source spectrometers for a wide variety of sample types. A major innovation in recent years was the development of a method for the direct analysis of drinking water samples by inductively coupled plasma mass spectrometry (ICP/MS) which eliminated a time consuming and less reliable preconcentration step.

The Spectroscopy/Waters Unit also provides analytical support to other units within the Inorganic Trace Contaminants Section through method development, instrument maintenance and training. A large number of research and development projects are in progress. These include both internal projects carried out by Unit personnel and external projects under the direction of the Unit through research contracts and Research Advisory Committee grants. The projects have the common goals of extending the analytical capabilities of the Unit through better detection limits, improved productivity and methods development for other sample types.

Specific short-term objectives are the development of an ICP/MS method for surface water samples and continuing methods development to support the various sectors of the MISA program.

MICROSCOPY/LITIGATION UNIT

This Unit has three main functions:

- the analysis of legal and complaint samples involving particulate matter and solids;
- the analysis of air and water samples for asbestos; and
- the coordination of the branch emergency and litigation efforts.

Using various microscopic and X-ray techniques, the Unit provides analytical support for Investigation and Enforcement Branch activities, regional abatement and air quality programs. The Unit responds to specific pollution events and public complaints by analyzing particulate matter and where possible, identifying the source.

The Unit receives legal, high priority and MISA samples for the branch and routes them to the appropriate sections for analysis. The Unit performs all of the administrative functions required to support the branch litigation efforts.

HAZARDOUS WASTE/LITIGATION UNIT

The Hazardous Waste/Litigation Unit consists of four inter-related sub-units. Each sub-unit (spectroscopy, hazardous wastes, mobile and litigation) provides technical and dedicated laboratory analytical support for regional and Ministry programs. As well, the mobile unit provides on-site analytical support for emergency and non-emergency applications.

The sub-units provide a multi-disciplinary approach to the analysis of litigation and routine environmental samples.

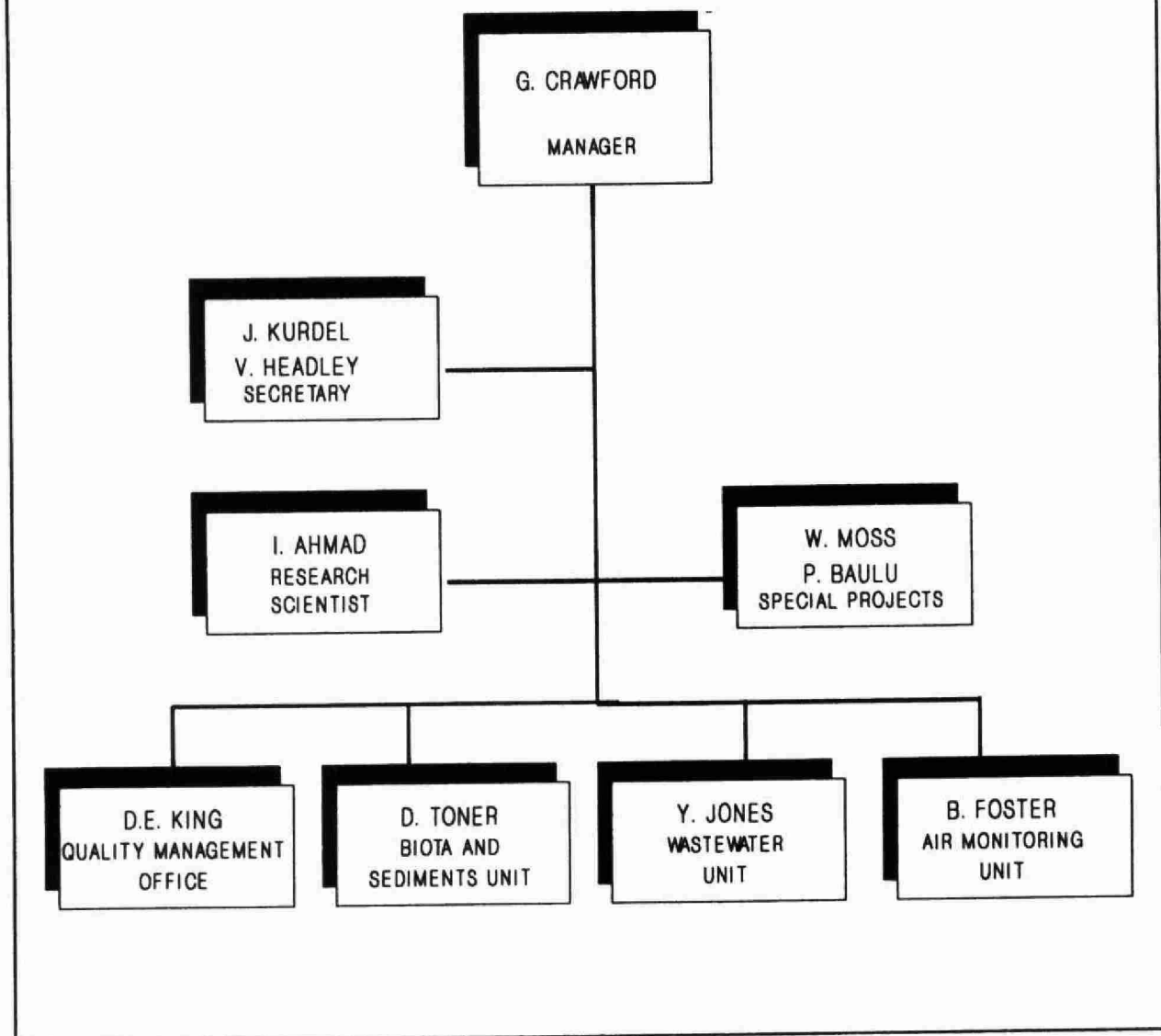
The spectroscopy sub-unit uses IR/FTIR and GC-MS techniques for the identification and characterization of organic derived hazardous waste materials.

The hazardous waste sub-unit specializes in the analysis of a wide range of matrices for PCB's and volatile chlorinated solvents.

The mobile sub-unit provides in-house and on-site technical support for the monitoring of organic pollutants in groundwater, effluents, leachate plumes as well as investigative aid in support of Investigation and Enforcement Branch activities.

The litigation sub-unit coordinates the activities of the individual sub-units and provides technical expertise and knowledge to clients for litigation purposes.

LABORATORY SERVICES BRANCH TRACE ORGANICS SECTION



TRACE ORGANICS SECTION

The Trace Organics Section's primary role is to identify and quantitate a wide variety of organic compounds of industrial and agricultural origin in all compartments of the environment.

The section is composed of three analytical units which perform a variety of analyses in a broad range of environmental matrices:

- Biota and Sediments Unit;
- Air Monitoring Unit;
- Wastewater Unit;
- Laboratory Services Branch Quality Assurance Unit responsible for laboratories Ministry-wide.

Each Analytical Unit normally specializes in the analysis of one or more sample classes (i.e. air, sediments, effluents, biomaterials, landfills or wastes) or in an analytical discipline (i.e. spectroscopy, advanced instrumentation, or various types of gas chromatography).

The section also supports the activities of the Laboratory Services Branch Quality Management Office responsible for quality assurance and quality control (QA/QC) for laboratories Ministry-wide.

Our activities include:

- Analysis of toxic organics in fish, biota and sediment;

- Analysis of trace organics in industrial and municipal effluents. (Support of the Ministry's Municipal-Industrial Strategy for Abatement-MISA);
- Analysis and investigation of landfill sites and clean-up operations;
- Analysis and monitoring of trace organics in air, emission samples, and precipitation;
- Analysis and characterization of solid and liquid industrial waste;
- Scientific expertise on environmental chemistry and monitoring of trace organics;
- Research and methodology development to accommodate new and emerging organics analysis needs;
- Overall branch coordination and technical liaison with clients in the development and delivery of regulatory and special programs (i.e. MISA, CAP).

Our overall goal is to provide high quality, efficient analytical services for monitoring and investigating trace organic pollutants in all aspects of the environment (excluding drinking and surface waters) in support of Ministry Field Investigations Programs. We also strive to develop and implement a Ministry-wide laboratory quality management program including performance audit and review.

BIOTA AND SEDIMENTS UNIT

This Unit provides routine and specialized analytical services and expertise for the determination and monitoring of a broad range of organic contaminants in three specific environmental compartments: Biota (fish, clams, various biomonitors, macrophytes), Sediments (sediments, soils, suspended particulate), Vegetation (terrestrial, aquatic).

Our primary task is to support the needs of a majority of Ministry Organics Monitoring Programs by providing analytical expertise for determination of many complex organic materials (i.e. pesticides, PCB's, and PAH's) at trace levels.

The Unit supports a wide range of programs. The Unit has been involved with the Fish Contaminants Program since its inception during the late 1970's, providing data on an annual basis on the scope and degree of contamination of Ontario's sport fish from mostly anthropogenic compounds. The Unit also coordinates analytical aspects of province-wide Biomonitoring Programs designed to use natural biological species within a given local or wide ranging aquatic environment to assess the level of organic contamination in both spatial and temporal terms. This type of information is used to evaluate the effects of imposed effluent regulations or monitor the overall state of health of a major aquatic system such as the Great Lakes.

Our overall goal is to maintain a state-of-the-art analytical facility for a broad range of organic contaminants in biota and sediment type samples. We also endeavour to provide prompt service, maintain a comprehensive data quality control program for our Unit and Section, and evaluate current analytical techniques while aiming for further improvements in quality and quantity of data issued. In addition, the Unit liaises with scientists from other Ministry branches and private companies to discuss, design and implement environmental programs aimed at evaluating low-level organics contamination.

AIR MONITORING UNIT

This Unit provides analytical support for the monitoring of organics in atmospheric samples including ambient air, precipitation, airborne particulates and atmospheric emission sources such as incinerators and industrial stacks. These analyses support Air Resources Branch and regional monitoring programs along with such inter-branch programs as Long Range Transport of Toxic Organics.

The Unit supplies the services for routine monitoring of PCB's and chlorobenzenes in ambient air, as well as providing analytical services to regional staff for the routine monitoring of volatile organic compounds emanating from landfill sites, vents, etc. The range of parameters includes mercaptans and alkenes. In conjunction with other laboratory sections, the Unit analyses stack gas samples for PCB's, chlorophenols, and chlorobenzenes using state-of-the-art sampling and analysis techniques.

One of our main goals is to develop new methods for the analysis of organics in ambient air samples and provide rapid turnaround analyses for on-site evaluations. While developing automated analytical instrumentation to enhance the Unit's capabilities, the group strives to implement and maintain effective quality assurance procedures for all aspects of the varied workload.

The Spectroscopy Group, as a part of the Unit, provides analytical services and expertise in the spectroscopic and wet chemical characterization and identification of organic contaminants. The techniques are uniquely applicable to polar and macromolecular substances including state-of-the-art gas chromatography coupled to Fourier Transform Infrared Spectroscopy. Routine tests include: Solvent-Extractables, Tannins, and Trace-Dyes. Samples are routinely analyzed for the presence or absence of petroleum-based contaminants often responsible for drinking and ground water taste and odour problems.

The group is also capable of characterizing chemical profiles of industrial effluents which is especially useful in cases of overloaded receiving waters or treatment plants.

WASTEWATER UNIT

The Wastewater Unit provides the branches primary capacity for analysis of target organics in municipal and industrial effluents. It also offers support services for the other units within the Trace Organics and Drinking Water Organics Sections by providing confirmational analyses and advanced sample processing techniques (i.e. clean-up, fractionation, isolation of organic contaminants from complex aqueous matrices).

The Unit applies gas chromatography and mass spectrometry to provide routine analysis of effluents and leachates for priority pollutants, PCBs, PAHs; a range of pesticides including organochlorine, organophosphorus and triazines; and a broad range of chlorinated and nonchlorinated volatile/semivolatile industrial organics.

Other activities include: Coordination of liaison in support of Ministry of the Environment Programs such as MISA, CAP and RAP; emergency response activities; and routine trace organics analysis in effluents and contaminated waters.

The Unit endeavours to maintain high quality assurance standards with maximum efficiency in sample processing.

QUALITY MANAGEMENT OFFICE

The Quality Management Office provides expertise to all Ministry laboratory facilities in the development and implementation of Quality Assurance Programs. The primary focus is towards laboratory operations, but the increasing need to design QA into projects prior to implementation has drawn staff into all areas of Ministry activity (i.e. the development of a position paper on the audit of the MISA Program).

The overall objective of this office is to advise branch and regional staff in documenting the individual section quality assurance programs, assess the implementation and success of routine data quality control, verify that all analytical services provided in support of Ministry programs meet required data quality needs and ensure that the quality achieved is documented and available for audit.

A critical factor in the success of a quality assurance program is the formal definition of duties and responsibilities of staff at all levels. A branch quality management plan has been developed which outlines the approach and primary areas of concern.

The successful application of analytical methodology to samples depends on complete documentation of the procedures and protocols to be followed. Changes in sample type often require adjustment of procedures. Formal method approval protocols are being established to ensure that all method changes which are likely to impact on the quality of data will be properly scrutinized and approved prior to use. All Ministry programs will be provided with specific analytical procedures used on their samples.

The valid interpretation of data over extended periods of time requires that data be accurate on average. Accuracy is established by analysis of standard reference materials and maintained by regular use of appropriate control materials.

The Quality Management Office is currently developing standard solutions at concentrated levels for the preparation of '**blind**' check samples. In addition, bulk quantities of water, wastewater, sediment, soil and vegetation samples are being developed for use as audit, control, and performance evaluation materials.

'**Round-robin**' and '**blind audit**' sample exchanges between laboratories provide some degree of validation of data quality. The performance of Ministry of the Environment laboratories in such studies initiated by external agencies has always been comparable to the best of the other participating analysts. Protocols have been established to ensure that these studies are used to improve the quality of analysis provided by Ministry laboratories whenever problems are identified, and a comprehensive internal program of blind audit submissions is being implemented.

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WATER QUALITY AND LABORATORY COMPUTER SYSTEMS SECTION

Water Quality Laboratory Units conduct a wide range of chemical and microbiological analyses for a broad spectrum of sample types in support of all major Ministry programs. Serving the entire branch, Laboratory Computer Systems (LCS) staff receive and organize samples, maintain the Central Laboratory Information System (LIS), provide computer services to two regional laboratories, support Laboratory Services Branch's privatization programs, and interact with the Ministry's Sample Information System (SIS).

WATER QUALITY UNITS

Water Quality Laboratory Units are the largest test-producing group in the Laboratory Services Branch. A multi-disciplinary team of chemical and microbiological staff utilize over 150 analytical methods to produce approximately 800,000 tests each year.

The Units support a large number of programs by providing expertise in the fields of inorganic analytical chemistry and microbiology. The sample types processed include air filters, precipitation, rivers, lakes, drinking waters, groundwaters, landfill leachates, sewage effluents, industrial wastes, and soils. Coordination of analysis and evaluation of data are handled at the supervisor and senior technician level.

Water Quality Laboratory Units comprise:

- Colourimetry
- Titration and Ion Chromatography
- MISA, BOD and Solids
- Dorset Laboratory and Atomic Absorption Unit

- Surface and Waste Water Microbiology
- Drinking Water Microbiology

All laboratory units maintain a vigorous quality assurance/quality control program. All steps of each procedure are monitored from reagent preparation to data approval in order to assure clients of the best possible product. Performance is also monitored on a weekly basis through participation in round-robins and analyses of third-party "unknowns". A quality assurance report, which summarizes and evaluates more than 250,000 QC tests, is issued annually.

To ensure continuing high quality analytical data and cost-effective operations, method development and equipment evaluation are a vital activity in all laboratories. Currently, fifteen such projects are underway.

COLOURIMETRY UNIT

The Colourimetry Unit analyzes samples for the following chemical parameters: ammonia, total nitrates, nitrite, reactive phosphates, total phosphorus, total Kjeldahl nitrogen, dissolved organic and inorganic carbon, chemical oxygen demand, chloride, colour, fluoride, and reactive phenolics. The Unit produces 320,000 analyses annually. An average throughput time of 14 days is maintained and analyses of perishable parameters are initiated within 48 hours of being queued on the LIS computer.

The Unit is 90% automated. Staff are in full control of the automated data processing procedures, greatly speeding the "paperwork" part of operations. Complex data reduction calculations and automated data transfer between the analytical equipment and the LIS system result in improved data quality and faster service to clients.

TITRATION AND ION CHROMATOGRAPHY UNIT

The titration and Ion Chromatography Unit analyzes samples for conductivity, pH, alkalinity, acidity, chloride, nitrate, and sulphate. The group produces about 150,000 analyses annually. Except for sample preparation (aqueous extraction of air filters and filtration of very dirty samples), analyses are fully automated including automated data processing and LIS communications.

MISA, BOD, AND SOLIDS UNIT

The BOD and Solids laboratories analyze samples for Biochemical Oxygen Demand (BOD), chlorophylls, solids, and turbidity. The group produces over 30,000 mostly manual tests per year. Computers are utilized for calculations and data transfer to LIS.

The MISA laboratory pre-screens audit samples from industries, performs pre-treatment or sample clean-up, and assists in coordinating sample throughput and quality control for regulated tests. The MISA laboratory also performs the two-stage total organic carbon (TOC) test and the reactive phenolics test using manual distillation.

DORSET LABORATORY AND ATOMIC ABSORPTION UNIT

The supervisor of these laboratories provides overall coordination of the Acid Precipitation in Ontario Study (APIOS) for the Laboratory Services Branch. The Unit operates two permanent field laboratories in Dorset. In one, precipitation, river and lake samples are analyzed for pH, alkalinity, dissolved oxygen, colour, conductivity, dissolved inorganic carbon, ammonia, total nitrates, total phosphorus and certain trace metals in support of the Intensive Aquatic Studies Task of APIOS. In the second laboratory, soil samples are analyzed for more than 20 different parameters in support of the Intensive Terrestrial Studies and Biogeochemical Studies.

The Dorset laboratories provide approximately 120,000 aqueous and soils test results annually in support of APIOS.

The Atomic Absorption Unit in Toronto analyzes samples for calcium, magnesium, hardness, sodium, potassium and by special request, chloramines.

The group produces 110,000 analyses annually. Cation analytical systems are fully automated with data reduction and data transfer to LIS.

SURFACE AND WASTE WATER MICROBIOLOGY UNIT

The Surface and Waste Water Unit performs a variety of bacteriological analyses on sample types such as lakes, rivers, groundwaters, sewage, and industrial effluents; the annual workload is approximately 20,000 tests. Analytical procedures are available for total coliforms, fecal coliforms, Escherichia coli, fecal streptococci, Pseudomonas aeruginosa, Klebsiella sp., and nuisance organisms (i.e. iron bacteria and sulphate reducers).

DRINKING WATER MICROBIOLOGY UNIT

This Microbiology Unit is responsible for the analysis of drinking water samples by a qualitative presence/absence test. When bacterial counts are required, quantitative tests are performed for specific bacterial groups. Approximately 35,000 tests are performed on distribution systems, reservoirs, groundwater and water treatment plant samples to ensure suitability of the water for domestic consumption. Indicator bacteria detected by this test include total coliforms, fecal coliforms, aeromonads, pseudomonads and staphylococci.

LABORATORY COMPUTER SYSTEMS UNIT

The Laboratory Computer Systems role is to support central and regional laboratory operations. The Unit operates, maintains, and enhances both the hardware and software components of the Branch's Laboratory Information System (LIS) and maintains and enhances the regional LIS systems. LCS provides sample reception, data entry services, and management reports for the Branch. In addition, the Unit investigates technologies that could increase productivity or improve the quality of the laboratory's product.

LABORATORY INFORMATION SYSTEM

The LIS is a software system that is used to collect submission information, route samples to the appropriate workstations, collect results and report those results to the Ministry's clients. The system currently consists of approximately 500 COBOL, 150 SPL and 50 FORTRAN modules running on a Hewlett Packard 3000 super minicomputer. This computer interfaces with both people and laboratory instrument controllers throughout the province. Instrument controllers range in size from a Perkin Elmer 3210 to Super Pet computers. All results generated in the Laboratory Services Branch or in private laboratories are reported through the LIS. When the result has been reported to the client, the corporate Sample Information System (SIS), which runs on an IBM mainframe at a remote site, is updated.

NEW TECHNOLOGY

LCS also investigates the use of new technology at the Laboratory Services Branch. Two initiatives that have increased productivity and product quality are the adoption of Bar Coding techniques and Direct Computer Input. Bar Coding of samples has aided sample tracking and data entry throughout the building. Direct Computer Input frees the laboratory technician from entering actual test results by letting the instrument controller format information and transmit results directly to the LIS database computer. In addition, LCS is currently investigating Laboratory Information Management Systems (LIMS) which would allow information about a sample to be retrieved from computing facilities at any one of the Ministry's five laboratories.



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